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Aquaculture in the Philippines is dominated by the culture of milkfish. However, one of the major drawbacks in milkfish culture is the high mortality encountered in rearing fry to fingerling stage. The causes of mortality could be due to stresses during collection, sorting, counting, transport and/or storage. The latter is attributed to water quality, feed and feeding practices. Lovell (1977) indicated that feeding practices are as important as ration formulation. The supplemental diet used should be nutritionally well balanced, palatable and of suitable particle size. Lim et al. (1978) determined the optimum protein requirement for milkfish fry in a controlled environment. They found that a diet containing 40 percent protein was optimum for the growth of milkfish fry stocked at 500 per m^2 in concrete tank and fed a diet consisting of 2 parts dry skim milk and 6 parts of fine corn meal for 2 to 3 weeks prior to releasing into nursery ponds reduced mortality from 10 to 15 percent as compared to the ordinary practice which was 50 to 70 percent.

The amount of feed given is very important in fish culture. If too much feed is given, more than the fish requires, some of it is wasted and the leftovers decay and foul the water which may be detrimental to the growth and health of fish. If too little feed is given approaching the amount required for maintenance, the growth is poor.

This experiment was to determine the relationships between feeding rate, survival rate and the growth of *Chanos chanos* fry in a controlled environment.

A semi-purified diet with casein as the protein source was prepared. The diet was formulated to contain 40 percent protein and approximately 3,450 kcal of metabolizable energy (M.E.) per kg (Table 1).

The experiment consisted of seven treatments with two replications per treatment. Treatments were assigned using a complete randomized design. Fish in two aquaria were given the experimental diet at daily rates of 4, 8, 12, 16, 20, 24 and 28 percent of the total body weight for 21 days. They were fed three times daily (one-third of the daily allowance at 9:00 A.M., one-third at 1:00 P.M. and one-third at 4:30 P.M.) and seven days per week.

Mass mortalities occurred on the 20th day of this feeding study for the treatment fed 12 and 24 percent of the biomass which caused the termination of the experiment. Examination of the fish in the pathology laboratory revealed bacterial infection identified as in the family of Enterobacteracae. Due to this reason, the survival rates of fish in various treatments at the end of the 19-day period were used.

The survival rates of milkfish fry were affected by the feeding levels but the effects were more pronounced at 14 and 19 day period. There seemed to be a general trend of increasing survival rates with increasing feeding rates. However, near maximum survival rate was obtained when the fry were given a daily feed allowance of 16 percent of the biomass. A daily feeding level of 16 percent of the biomass could thus be considered optimum for the satisfactory survival rate of milkfish fry held in a controlled environment, Table 2.

Average weight gains seemed to be related to feeding rates (Table 3). Based on the average weight gain, a daily feed allowance of 4 percent of the body weight is above the maintenance level since fry in this treatment gained 46.8 percent in weight after the 27 day feeding period. However, when the feeding rates were raised to 8 and 12 percent of the biomass the weight gains increased slightly.

Fish fed 28 percent of the biomass had the highest weight gain, but had lower survival rates at 7, 14, and 19-day periods as compared to those fed 16, 20 and 24 percent levels. Slightly lower weight gain in the 24 percent biomass treatment, highest NH_3-N concentration of the water and the heavy mortality caused by bacterial infection at the 20th day could also be a result of excess feeding. This indicates that a daily feeding rate of 20 percent of the biomass is optimum for growth of milkfish fry.

The NH_3-N concentration of the water is directly related to the level of feeding except for the 28 percent biomass treatment. The slight decrease in NH_3-N concentration in the treatment receiving the highest feeding rate cannot be explained. The highest value of NH_3-N (0.56 ppm) observed in the treatment fed 24 percent of the biomass may have inhibited the growth of milkfish fry since the average weight gain of fish in this treatment is slightly lower than that of the 20 percent biomass treatment.

The optimum daily feed allowance varies with species, age, size, frequency of feeding, culture procedures, quality of feed and water quality. However, results of this experiment indicated that with a diet containing 40 percent protein and 3,450 kcal of M.E. per kg, a feeding rate of 16 to 20 percent of the biomass is optimum for satisfactory survival and growth of fry raised in a controlled environment. Increasing the feeding level beyond this value was not beneficial but in turn increased the ammonia-nitrogen concentration to a level which is harmful to the fish.

Table 1. Composition of the experimental diet

Ingredient	Percentage of ingredient
Casein	44
Dextrin	31.2
Cod liver oil	3
Corn oil	3
Carboxymethyl cellulose	3
Vitamin mix[1]	3
Mineral mix[2]	5.6
B. H. T.	0.02
Celite	7.4
Estimated protein (%)	40
Estimated M. E. (kcal/kg)[3]	3,450

[1]Vitamin mix (mg/kg diet): thiamine, 10; riboflavin, 20; pyridoxine, 15; folic acid, 5; pantothenic acid, 40; choline chloride, 3,000; niacin, 150; vitamin B_{12}, 0.02; vitamin A, 4; vitamin D, 10; vitamin E, 50; menadione-Na-bisulfite, 80; inositol, 400; biotin, 2; vitamin C, 300; B. H. T., 0.5; celite 25,913.48.

[2]Mineral mix (g/kg diet): $CaHPO_4.2H_2O$, 20.7; $CaCO_3$, 14.8; KH_2PO_4, 10.0; KC1, 6.0; $MnSO_4 . H_2O$, 0.35; $FeSO_4 . 7H_2O$, 0.5; $MgSO_4$, 3.0; KIO_3, 0.01; $CuSO_4 . 5H_2O$, 0.03; $ZnCO_3$, 0.15; $CoCl_2$, 0.0027, $NaMoO_4 . 2H_2O$, 0.0082; Na_2SeO_3, 0.0002.

[3]Estimated M. E. was based on mammalian physiological fuel value:

Protein: 4 kcal/g; Fat: 9 kcal/g; Carbohydrate: 4 kcal/g.

Table 2. Survival rate of milkfish *(Chanos chanos)* fry receiving various levels ot feeding

Feeding rate (%) biomass	Average survival rate (%) at different periods (days)[1]		
	7	14	19
4	92.5[a]	51.3[a]	33.1[a]
8	96.3[a]	66.3[a]	46.9[a]
12	96.3[a]	78.8[ab]	68.8[b]
16	98.1[a]	88.1[b]	78.8[b]
20	99.4[a]	85.0[ab]	80.0[b]
24	96.3[a]	91.9[b]	80.6[b]
28	96.3[a]	81.9[ab]	74.4[b]

[1]Treatment means with the same superscript are not statistically different ($P < 0.05$).

Table 3. Average weight gain and survival rate of milkfish (*Chanos chanos*) fry, and ammonia-nitrogen content of water receiving different levels of feeding[1]

Feeding rate (% biomass)	Av. init. wt. (mg)	Av. wt. gain per fish (mg)	Av. survival rate (%)	NH_3-N in water (ppm)
4	7.7	3.6^{a}	33.1^{a}	0.11^{a}
8	7.7	4.1^{a}	46.9^{a}	0.16^{a}
12	7.7	5.7^{ab}	68.8^{b}	0.24^{ab}
16	7.7	11.7^{abc}	78.8^{b}	0.44^{bc}
20	7.7	16.0^{c}	80.0^{b}	0.49^{c}
24	7.7	15.4^{bc}	80.1^{b}	0.56^{c}
28	7.7	20.4^{c}	74.38^{b}	0.35^{abc}

[1] Treatment means with the same superscript are not statistically different ($P < 0.05$).

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